Double-dot - application

The importance of the double-dot coating increased tremendous during the last years. They bear several advantages, like strike-back free, better dot shape, lower add-on, higher adhesion and soft textile hand. The improved strike-back is the major driving force in the development, especially in the so-called sandwich-application, where multiple interlinings are fused to the top cloth in a single step.

A. Advantage and use of the Double-dot

To close the gap between woven and non-woven, interlinings became more lighter and softer and new fabrics, like PES - charmeuse (35 g / m^2) were developed. But as usual not only advantages were generated. These new materials have a very open surface and therefore traditional coating techniques, like paste and powder dot, fail. The coated dot penetrates deeply into the interlining, which results in inadequate bond strength and stiffness. With the powder dot process the interlining looses also its elasticity.

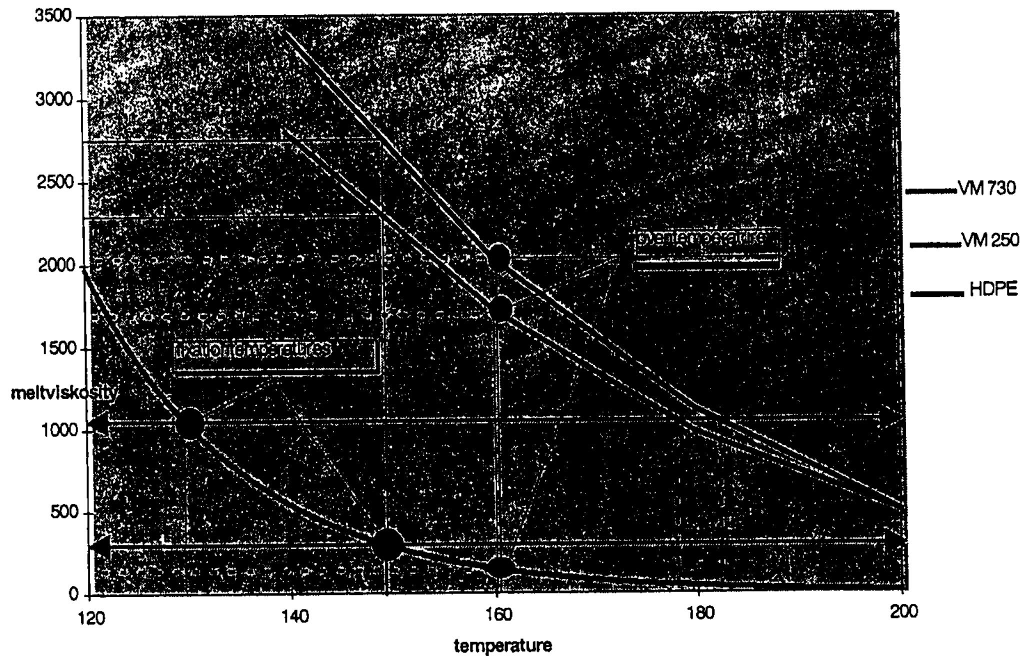
A major advantage of the double dot is the construction of the dot itself. Especially the bond strength is greatly improved. The fashion in the last years brought out new fabrics, which are difficult to bond, like Polyester - and Viscose georgette, micro fibre with special finish (siliconized or fluorcarbonized), etc..

With common coating techniques a good adhesion could not be achieved. The lower portion of the double dot construction is mainly a high viscous, sometimes a crosslinked coating. This barrier prevents the penetration of the adhesive into the interlining. Therefore the adhesive stays on top of the dot and almost 100% can be used to bond the fabric.

A great interest for these kinds of interlinings is in the Asian market, where they work with high Mesh and soft, open materials.

The following chart describes the relationship between coating - and fixation temperature and the corresponding melt viscosity.

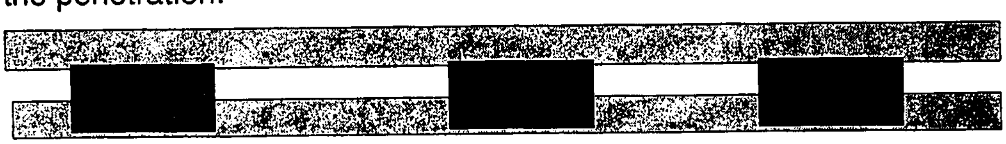
Dependence of the meltvicosity from the temperature by the Doubledot



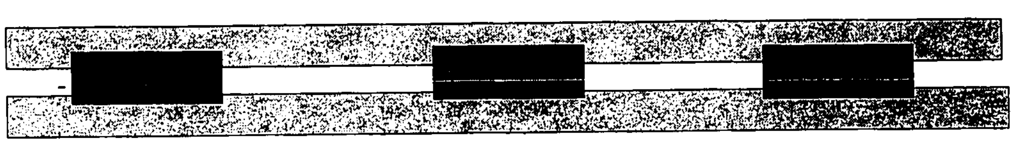
The chart above shows the behaviour of a powder filled paste. By using a crosslinked base dot this effect is even more interesting, since this dot cannot be molten.

The next picture visualises the behaviour of the coated dots during coating and fixation in dependence of the coating system.

In the following picture it is demonstrated, that the Paste - or Powder dot penetrates into the interlining during the fixation. The double dot behaves differently, because of its high viscosity. The lower portion of the dot, the base dot, prevents the penetration.



Powderdot after the fixation



Doubledot after the fixation

A law of nature describes that everything moves in the direction of the lowest resistance. This law is also valid for this application. The adhesives dots applied via powder dot disappear into the interlining and do not adhere to the top cloth. The high viscous barrier of the double dot forces the adhesive into the top cloth. A higher amount of adhesive is naturally accompanied with higher bond strength.

B. Printing screens

Currently two types of screens are established:

- **linear screens (...Mesh)**
- **Computer screens (CP...)**

As the name indicates, the linear screen shows the dot lines with defined distances, where as the computer dot is an irregular dot with variable distances. At linear screens sometimes an optical structure is visible, the „MOIRE-Effect„ born by too much draw to the interlining during coating. This effect disturbs the quality-check. This is not possible with a computer dot pattern.

The calculation from Mesh to CP... is easy:

CP -----> Mesh = $\sqrt{\text{CP-number}} \times 2{,}5$

CP 66 = $\sqrt{66} \times 2{,}5$ =20 Mesh

Mesh ------> CP = $(\text{mesh} \times 2{,}5^{-1})$?

30 Mesh = $(30 \times 2{,}5^{-1})$? = CP 144

Common screens are:

Mesh	CP
11	35
13	47
15	52
17	66
20	78
25	110
30	170

Depending to the final product you have to select the right screen:

Non-woven weight	screen	add on	use
15 –20	*25 -30 Mesh CP 66 -CP170*	6 - 8 g	*DOB,blouses, shirts*
25	*20 -25 Mesh CP 66 -CP 78*	8 - 10 g	*DOB,costumes, blazers*
>40	*11 - 17 Mesh CP 35 - CP 52*	10 - 12 g	*HAKA,suits,coats frontfixation*

C. Resistances

The selection of the hot melt is mainly based on the application profile. The potential customer has to define his specific needs.

The following properties are very common:

- **low strike-back or strike-through**
- **sandwich fixation**
- **washing- and dry cleaning resistance**
- **wide fixation range**
- **steam resistance**
- **'sand-wash'**
- **adhesion to difficult cloth-fabric**

Strike-back, strike-through resistance

Normally a higher melting hot melt is required.

Sandwich fixation

The sandwich fixation stacks at least two fixation parts (interlining plus cloth), that are then fused to increase the production speed. The stacking of the 4 parts is as follows:

- **cloth-fabric**
- **interlining**
- **interlining**
- **cloth-fabric**

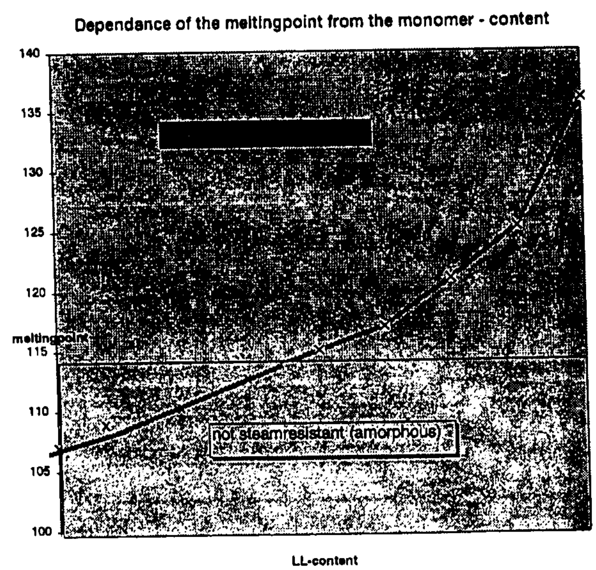
If the hot melt has a strike-back, both interlinings will fuse together. It is necessary that they peel off very easy after fixation. A common test is, to look for adhesion of a 10 cm strip. Preferred is that there is no adhesion between the two

interlinings, sometimes up to 1 N/ 10 cm can be tolerated, a higher bond strength is not satisfactory.

Washing- and dry-cleaning resistance

The chemical structure and nature of the polymer defines the resistance against washing and dry-cleaning. In general, a high amount of lauryllactame increases the wash resistance, therefore grades, like VESTAMELT 230 and 250 are the best choices for washing at 60 and 90 degree C. All other copolyamides and co-polyesters withstand maximum 30 to 60 degree C washing. Polyamides have an excellent dry-clean resistance, Polyester normally fail. But it is possible to improve the dry-cleaning resistance with special ingredients, which is commonly used in paste application. For powder dot application only the high melting polyester grades, VESTAMELT 4280, has the required dry cleaning resistance.

Resistance to steam and wide fusing conditions



One of the last steps in the manufacturing of clothes is the steam treatment to form the clothing into its final shape. It is important that the bonding withstands this treatment. Otherwise, large bubbles between interlining and the fabric may occur. To avoid such delamination the melting point of the hot melt should be above 115°C. The LL - content of a polyamide should be higher than 45 %. In this case the cristallinity high enough, that steam, which has a plasticizing effect, does not effect the bond.

The following chart shows the relationship between the melting point of **VESTAMELT 730** and the amount of Lauryllactame.

It is not necessary to use only hot melts with high melting temperatures. If the adhesive contains 40 to 50 % of a high melting copolyamide, like **VESTAMELT 230** or **250,** usually the bond will not be damaged by steam. Therefore it is possible to create recipes, which allow wide fusing conditions and also provide good resistance to steam.

Resistance to sandwash

'Sandwash" is a special procedure to finish textiles. Its goal is, to get a rough surface of the finished textiles. In this case the textiles will be washed at approx. 80°C with alkaline chemicals and fine sand to get the preferred appearance. The bonding between interlining and top cloth has to withstand not only high mechanical stress, also a harsh chemical environment. Thus, copolyamides with high resistance to hydrolysis have to be recommended like **VESTAMELT 230 or 250**.

Substrates with difficult surfaces

Especially in the field of ladies wear, fibres and top clothes become exotic. Special drilled yarns, fibres, finishing with silicones and fluorohydrocarbones come in fashion. Textiles made of micro fibres, silk, viscose, polyester georgette and rayon are typical. But, it is very difficult to bond such top clothes.

We know, that our customers work with plasticized pastes where the MFR-value is about 150 g/ 10 min at a temperature of 140¡C. To reach such a value they have to add 10 - 20 % plasticizer calculated to the hot melt powder.

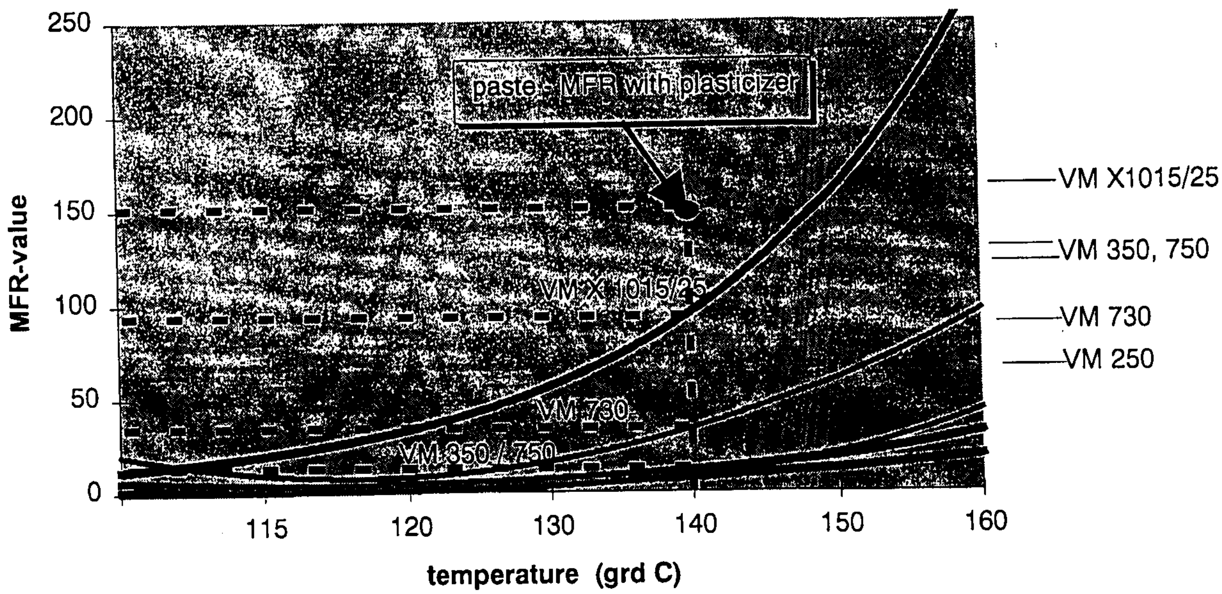
But, there are other opportunities to solve this problem. A low melt viscosity is required to achieve a good wetting of the fibres. A typical hot melt with the required low viscosity is **VESTAMELT 730. VESTAMELT 730** has a melt flow rate around 100 g/10 min and the P816 fraction is successfully used in double dot applications to bond those fabrics.

Copolyamides or copolyesters with a similar low viscosity, i.e. with a melt flow rate around 200 g/10 min, can be used as hot melt, which do not require plasticizer.

The adhesion after fusing at 125°C to some modern top clothes of silk, polyester - georgette and viscose - georgette, is approx. 6 - 8 N/5 cm; three to four times higher then common interlinings. Those results are first tests of a trial product. With the **VESTAMELT X1015 and X1017 HÜLS** developed such polymers with very low melt viscosity and lower content of caprolactame.

The following chart demonstrates the advantage of the new polyamide compared to the common ones.

Dependance of the MFR - value from the temperature



Another possibility is the addition of epoxide resins. Some epoxide resins have good adhesion properties. Due to the low melt viscosity, these resins act as a reactive plasticizer.

How to decide between two applications:

- **powder filled paste base**
- **powder free paste base**
  - **Acrylic-dispersion**
  - **PUR-dispersion**

In both applications the top dot is a low melting hot melt adhesive powder, scattered on top of the base dot.

The Double dot is a combination of a screen print- (paste) and powder scattering-application. The scattered powder adheres well to the wet paste dot. The scattered powder, which does not stick to the wet base is blown away, exhausted and/or recycled. Sometimes a special roll vibrates the interlining before the powder is exhausted. It is important to work with an overload of powder to cover all paste dots.

After exhausting of the overloaded powder, the double dot is preheated by infrared and afterwards dried by hot air in an oven. Under those condition the top dot is securely fastened to the base dot. In general the base dot has a higher melting

point and melt viscosity then the hot melt on top, to prevent for strike-back. To achieve an even higher resistance the base dot is sometimes crosslinkable (polyacrylates).

Kind and shape of the base dot depends on the fabric used for the interlining and the coating. Very light fabrics, like charmeuse (30 - 50 g/m²) and non-woven (15 to 25 g/m²) prefer a basis of acrylics or polyurethane, printed with screens of 25 to 30 Mesh. Heavier ones, like knitted interlinings > 70 g/m² should be coated with a powder filled system and coated with screens of 11 - 17 Mesh or CP 46 - CP 66.

Formulation for a water-based system:

1. **Water (50 - 70 %)**
2. **Thickener**
3. **Ammonia**
4. **Dispersing agent**
5. **Running conditioner**
6. **Hot melt-powder or dispersions of acrylate or polyurethane**

The next schedule shows common additives

Additives	chem. base	commercial name	Supplier
Thickener	polyacryl-acid polyurethane cellulosederivates	***MIROX HP*** ***Collacral 8500*** ***METHOCEL***	Stockhausen BASF DOW
Dispersing agent	ethoxylated fatty alcohol	***INTRASOL 12/18/5***	Stockhausen
Wetting agent	polysiloxane cobin. of tensids	***TEGOPREN 5847*** ***SULTAFON UNS***	Goldschmidt AG Stockhausen
Defoamer		***ANTISPUMIN DJ***	Stockhausen
Printing agent	ethylenadduct polyethylenoxid	***MIROX OX*** ***MIRAPLAST NVP***	Stockhausen Dr. Th. Böhme
Hot melt-powder	copolyamides	***VESTAMELT 251*** ***VESTAMELT 751***	HÜLS AG
	copolyesters	***VESTAMELT 4280***	HÜLS AG
	HDPE	***Schättifix 1820***	Schaetti & CO
Acrylics	thermoplastic crosslinked	***PLEXTOL DV 604*** ***PLEXTOL BV 595***	Röhm Röhm

Additives	chem. base	commercial name	Supplier
Polyurethane	Mp 185 °C	***FIXAMIN PU 631***	Stockhausen
Latices	SBR	***ATEVAL 84*** ***LIPOLAN TV 6533***	Dr. Th. Böhme HÜLS AG

The concentration of the additives for the base dot may be different, depending on the fabric and the surface of the interlining and must relate to the dot shape and the line speed of the machine.

Dispersion-base dot:

Powder filled systems are described well. Two more systems are important. They are used as 18 % solutions. To achieve the right viscosity a thickener, e.g. MIROX HP (Stockhausen) is added. The both systems are different in mechanism, printability and behaviour. They are used for Charmeuse-interlinings and high Mesh.

Acrylic (PLEXTOL BV 595)

The Acrylic is a thermo-crosslinking product that reacts under decomposition of water. It is possible to catalyse the crosslinking with acids. The open time must be so long, that the system can be coated at room temperature. In general Acrylics with film forming temperatures from above 40 °C should be used. The Acrylic should crosslink when the top dot begins to melt, otherwise the powder can loose its connection can happen to the base dot. Very critical is the washability. Acrylic normally swells with water, which can result in a loss of adhesion. Also the Double dot is treated with great pressure, which can disturb the connection between the two dots.

Polyurethane (FIXAMIN PU 631)

With the Fixamin from STOCKHAUSEN an interesting product is in the market. It is thermoplastic Polyurethane with a softening-point of over 150 °C and high melt viscosity. Because film forming is not depending on a reaction, it is possible to run with higher speed as with the Acrylics. The swelling by water is less and the thermoplastic character improves the adhesion of the top dot to the base dot. The open time is comparable to the Acrylics and works well. The textile hand is a little bit better then the Acrylics.

Useful Powders for the top dot:

The choice of the scattering powder depends on the required properties of the interlining.

VESTAMELT 730 and 430-P816 are improved powders for low melt-applications with good adhesion and difficult to fuse fabrics. They have out-standing properties for PUR- and Acrylic-base dots. For powder filled base dots the best powder we recommend

VESTAMELT X1301-P816. For good steam resistance the new developed grades from **HÜLS**, **VESTAMELT X1015** and **X1017** are recommended.

The double dot-application has many advantages, but also some drawbacks:

- **high investment costs of machinery**
- **high production costs**
- **low line speed**
- **difficult to run**
- **no soft textile hand**

You can run the powder filled base dot with high speeds (because of low Mesh), but for the dispersing dot the line is limited to 20 m/min, because you have to run fine Mesh (25 - 30 Mesh) and the also the crosslinking of the Acrylates is very slow. If you catalyse this reaction with acids, they react quicker, but acids cause difficulties at the printing, because the surface of the screen becomes sticky and the coating gets faults. Also the base dot can crosslink before the scattering powder can melt, which results in no adhesion between the base dot and the top dot. Even after washing the hot melt disappears form the base dot. The result is that the interlining peels from the cloth.

Paste recipes for Double dot - coating (base dot)

Powder filled paste:

Water	60,0 kg
MIROX HP	1,5 kg
INTRASOL 12/18/5	3,0 kg
VESTAMELT 751-P1	12,0 kg
HDPE-powder	18,0 kg
ANTISPUMIN	0,2 kg
MIROX OX	1,0 kg

Acrylic-paste:

Water	400,0 g
Defoamer	5,0 g
Ammonia	20,0 g
Plextol BV595	600,0 g
Plextol DV440	400,0 g
Methocel 75	1,5 g
Fixamin PU 631	1000,0 g

Polyurethane can be used instead of Acrykates (Plextol),

Construction of a Double dot coating line

The Double dot coating line is a very sophisticated equipment. It contains the following parts:

- **Paste head**
- **Scattering-unit**
- **Powder exhaust**
- **Air jet**
- **Powder recycling**
- **IR-preheating**
- **Drying oven**

Line speed and effective powder exhaust are depending on the quality of the equipment. Very important is the recovery of the overflow-powder and the drying oven. Both have the main effect on the line speed.

Several years ago picking bowls were used for exhausting the powder, but realty proved, that the powder was not only centrifuged, but also penetrated powder into the interlining. Today the powder is blown away by air jet. The more the air flows laminar, the better the result of exhausting, even better, if the exhaust is aerodynamic optimised.

The recycling - powder is cleaned from fibres and added with an amount of 40 % to new powder.

A hot air oven is used for paste coating. In addition it is important to have an IR-field in the front and at the rear of the oven. The field at the front has to agglomerate the top dot as quickly as possible and to get a good bonding to the base dot. The rear field will fuse both dots together.

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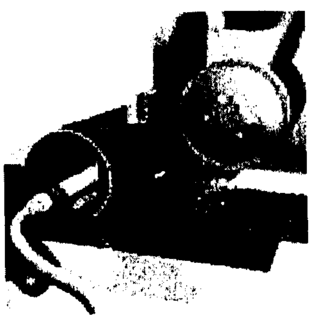
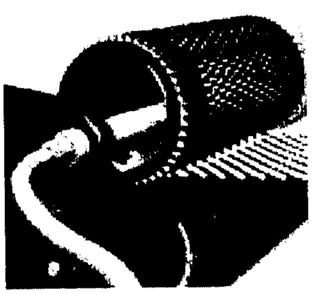
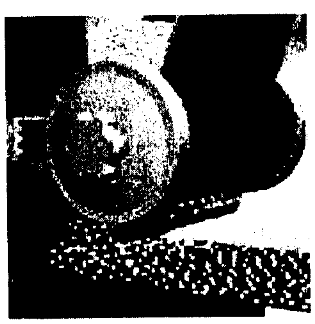
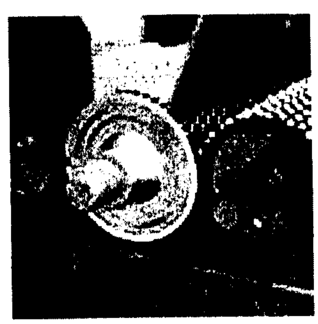
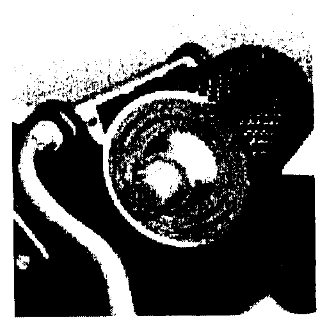
High Performance Polymers

VESTAMELT®

Copolyamides and Copolyesters
Hotmelt Adhesives



- Paste Dot
- **Double Dot**
- Powder Scattering
- Powder Dot
- Hotmelt Print / Extrusion

A double dot consists of a highly viscous or cross-linked base dot and a low-viscous top dot. This allows light and open face materials to be bonded to equally open linings without strike back, without the adhesive penetrating the fabric, and without the back of the material sticking to the machine. Other advantages include a low application weight, better adhesion to surfaces that are difficult to fuse, and a soft textile feel.

Application method
In recent years, new base materials such as polyester charmeuses (about 35 g/m^2) have come into use to close the gap between nonwoven fabric and woven lining. Because these materials have open surfaces and are also very temperature-sensitive, it is not advisable to use paste dot or powder dot coatings. In both methods, the coating dot is pressed too deeply into the lining, causing hardening. Powder dot coating has the additional disadvantage that the lining is subjected to too much thermal stress, impairing the product's elasticity.

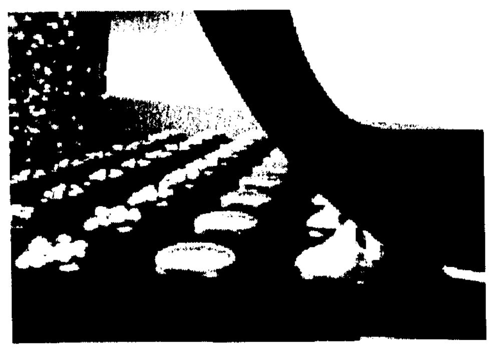
A newly developed coating technology, the double dot process, is ideal for coating and bonding these materials, however. As seen in the figure, the double dot sinks into the lining very little compared to the other two processes because the base dot has a high viscosity.

1. Rotary-screen printing is used to apply the base dot.
2. A powder adhesive that will adhere only to moist paste dots, is next scattered on the base dot while it is still moist.
3. Any top-dot powder that falls between the base dots is removed by aspiration in a later step.
4. The water is removed from the base dot within a dry channel. The base dot is sintered to the lining substrate, and both dots are bonded together.

A double dot produced in this manner consists of approximately 3–5 g/m^2 base dot and 4-5 g/m^2 top-dot material.

Fusing
Fashionable face fabrics, such as polyester and viscose georgette and microfibers, are provided with a special finish (siliconizing or fluorocarbonizing). Conventional systems fail to bring about adhesion in these materials because suitable low-viscous hotmelt adhesives will seek the path of least resistance and strike back deep into the liner (see figure).

In the double dot process, the base dot forms a highly viscous barrier layer that prevents strike back into the liner. The top dot's hotmelt adhesive is forced to run in the direction of the face fabric, resulting in good adhesion due to its good bonding to the base dot and its excellent wetting of the surface (see figure).



Behavior of the coating dots during fusing as a function of the coating process

Design of the double dot system
The double dot system is by far the most elaborate application system. It consists of:

- paste head
- scattering device
- powder aspiration
- air nozzle
- powder recycling
- drying oven
- IR melting

The quality of the individual components and proper match between the materials, the base adhesive, and the top-dot adhesive is crucial to the success of the double dot process. When everything has been properly matched, running speeds of 50 m/min are possible. The two most critical factors affecting the rate are the aspiration of the excess powder and the design of the drying oven.

Just a few years ago, beater rolls were used to fling up the excess powder and aspirate it. Experience has shown that the powder was not only flung upward, but was also shaken down into the lining, where it caused hardening and higher material consumption. Today the powder is removed by air nozzles located in the front and rear of the aspiration device. The more laminar the air stream, the more effectively the excess powder is cleaned from the lining. This means that eddying must be prevented, requiring an aerodynamically optimized suction system.

The aspirated powder is freed of fibers and agglomerates. About 40 percent of this recycled powder is mixed with the original powder and recycled to the process.

Another factor is the drying oven. The paste dot process uses only circulating air ovens, but they are not adequate in this case. Instead, it is recommended that IR fields be installed at the oven inlet and outlet. The IR field at the inlet is intended to agglomerate the scattered top dot material as quickly as possible and fasten it to the base dot. The top dot is fused to the bottom dot at the oven outlet.

VESTAMELT copolyamides for the powder filled base dot

VESTAMELT	**Properties, Suitability**
250-P1	High melting point and high melt viscosity, very good resistance to strike back, very good resistance to temperature, washing and steam
X1310-P1	Thermal cross-linkable hotmelt adhesive Before cross-linking: low melting point and low melt viscosity, good adherence to copolyamide top dot
X1316-P1	Thermal cross-linkable hotmelt adhesive Before cross-linking: higher melting point and higher melt viscosity, for high resistance requirements

Particle sizes:
P1 = 0 to 80 µm
Grades can be blended to produce different properties.

VESTAMELT copolyamides for the scattered top dot

VESTAMELT	**Properties, Suitability**
430-P816 430-P2	Low melt viscosity with good resistance to steam, for pressure-sensitive and thermally sensitive face fabrics, ladies wear
730-P816	Low melting point, low melt viscosity, very good adhesion to surfaces that are difficult to fuse, such as siliconized fabrics
840-P816 840-P2	Wide fusing range, high resistance to steam, good adhesion strength, multi-purpose grade for different interlinings
X1017/25-P816	Very low melt viscosity, excellent adhesion to textiles that are difficult to fuse, well adapted to lightweight substrates
X1027-P816	Low melt viscosity, low fusing temperature, very good adhesion to surfaces that are difficult to fuse, high resistance to steam, good for colored linings
X1301-P816 X1301-P2	Wide fusing range, very good adhesion and soft feel, very good resistance to washing and hydrolysis

Particle sizes:
P816 = 80 to 160 µm,
P2 = 80 to 200 µm

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